Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/36**

Paper 3 Advanced Practical Skills 2 **October/November 2019**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Rounding errors (RE) and transcription errors (TE) are penalised only once in the paper.

Question	Answer	Marks
1(a)	**I** All the following data recorded • two burette readings and titre for the rough titration • initial and final burette readings for **two** (or more) accurate titrations	**1**
	II Titre values shown, for accurate titrations **and** Appropriate headings and units in the accurate titration table • initial / start and (burette) reading / volume • final / end and (burette) reading / volume • titre **or** volume / **FB3** and used / added *(not 'difference', 'amount', 'total')* unit: / cm^3 **or** (cm^3) **or** in cm^3 (for each heading) **or** cm^3 unit given for each volume recorded	**1**
	III All accurate burette readings are to the nearest 0.05 cm^3.	**1**
	IV The final accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**
	Award **V** if $\delta \leqslant 0.80$ (cm^3) (Where δ is difference to the supervisor's value)	**1**
	Award **VI** if $\delta \leqslant 0.50$ (cm^3)	**1**
	Award **VII** if $\delta \leqslant 0.30$ (cm^3)	**1**
1(b)	**Candidate calculates the mean correctly.** • Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. • Working / explanation must be shown ***or*** ticks must be put next to the two (or more) accurate readings selected. • The mean should be quoted to **2 dp** and be rounded to nearest 0.01 cm^3.	**1**
1(c)(i)	**All** quoted answers in **(ii)**–**(v)** are expressed to 3 or 4 sig fig. Minimum of 3 answers displayed to qualify for this mark.	**1**
1(c)(ii)	**Correctly calculates no of moles of HC*l* used.** No of moles HC*l* = $0.5 \times {}^{25}/_{250} \times$ answer **(b)**$/_{1000}$	**1**
1(c)(iii)	$Ca(OH)_2 + 2\,HCl \rightarrow CaCl_2 + 2H_2O$ **and** Correctly calculates number of moles of $Ca(OH)_2$ = 0.5 × answer in **(ii)**	**1**

Question	Answer	Marks
1(c)(iv)	**Correct use of (iii) to calculate concentration of $Ca(OH)_2$ in FB 1** Concentration $Ca(OH)_2$ in **FB 1** = ans **(iii)** × 40	**1**
1(c)(v)	**Correct use to obtain mass of $Ca(OH)_2$** Mass of $Ca(OH)_2$ = answer **(iv)** × 74.1	**1**

Question	Answer	Marks
2(a)(i)	**Six pieces of data shown, with unambiguous headings and correct units.** • (mass of) container and **FB 4** • (mass of) container (plus residue) • (mass of) **FB 4** used • first / start / initial (temperature) / T of **FB 6** • final / highest (temperature) • (temperature) rise / change	**1**
	Precision of readings shown in 2(a) and 2(b) • all four thermometer readings are shown to 0.0 or 0.5 °C • both balance readings for each experiment are shown to same number of d.p. • masses and temperatures subtracted correctly	**1**
	Accuracy (Q) mark If δ is less than or equal to 2.0 °C, award this mark	**1**
2(a)(ii)	**Correctly calculated answer** Energy change = 40 × 4.2 × temp rise	**1**
2(a)(iii)	**Correctly calculated moles of $Ca(OH)_2$** Moles of **FB 4** = $^{\text{mass used}}/_{74.1}$	**1**
2(a)(iv)	**Correct use** • Δ H = **(ii)** / **(iii)** × 1000 • Negative sign must be shown on answer line. • Answer should be expressed to 2, 3 or 4 sig fig	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="2">2(b)(i)</td><td>Readings written in space provided
• Two thermometer readings are recorded both above 10 °C
• Two masses are recorded giving mass of CaO between 0.5–2.0 g.</td><td>1</td></tr>
<tr><td>Two accuracy marks
• Calculate the difference between corrected candidate's and supervisor's temp rise (δ)

See table for accuracy marks.

<table>
<tr><td>Sup ΔT_{max}</td><td>⩾ 25.5 °C</td><td>25.0–15.5 °C</td><td>15.0–10.5 °C</td><td>10.0–5.5 °C</td><td>< 5.5 °C</td></tr>
<tr><td>1 mark</td><td>$\delta \leqslant 3.0$ °C</td><td>$\delta \leqslant 2.5$ °C</td><td>$\delta \leqslant 2.0$ °C</td><td>$\delta \leqslant 1.5$ °C</td><td>$\delta \leqslant 0.5$ °C</td></tr>
<tr><td>2 marks</td><td>$\delta \leqslant 2.0$ °C</td><td>$\delta \leqslant 1.5$ °C</td><td>$\delta \leqslant 1.0$ °C</td><td>$\delta \leqslant 0.5$ °C</td><td>not available</td></tr>
</table></td><td>2</td></tr>
<tr><td>2(b)(ii)</td><td>Correct expressions shown for enthalpy change
• Energy released (40 × 4.2 × temp rise)
• No of moles used = $\frac{\text{mass of } \mathbf{FB\ 4} \text{ used}}{\mathbf{56.1}}$
• $\Delta H = \frac{\mathbf{energy}}{\mathbf{no\ of\ moles} \times \mathbf{1000}}$
• An attempted answer, quoted to 2 or more sig fig
• Negative sign in answer</td><td>1</td></tr>
</table>

Question	Answer	Marks
2(c)	**Possible working:** **Attempt at Hess Cycle diagram or clear working shown** • Downward arrow from $Ca(OH)_2$ • Downward arrow from CaO **OR** **Use of equations** $Ca(OH)_2(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + 2H_2O(l)$ $CaO(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l)$	**1**
	Correctly uses values for ΔH**, with sign correct** ΔH = **(a)(iv) – (b)(ii)** *Correct answer with some working gains both marks.* *Correct answer with no working gains one mark.* *Wrong answer – look at working and award one mark if appropriate.* *If default values are used,* $\Delta H = +27$ *kJ mol*$^{-1}$	**1**
2(d)(i)	Temperature rise / change would be the same **and** because acid is used in excess / CaO is the limiting factor	**1**
2(d)(ii)	No, because there is no 'frothing up' / spitting out of reagents / no acid spray **or** No, because a taller cup would not (significantly) reduce heat loss	**1**

Question	Answer	Marks
	FB 7 is $ZnCO_3$; **FB 8** is KI; **FB 9** is KNO_2	
3(a)	**Observations when FB 7 is heated** • Condensation / water droplets / steam produced • solid becomes fluidised / powder jumps around • solid turns yellow / yellow-green (when hot) • solid goes white or paler <u>when cooled</u> Award 1 mark for two correct points from the list, award 2 marks for three or more correct points from the list.	**2**
	(Gas) turns limewater milky / chalky / white precipitate / cloudy white	**1**
3(b)(i)	**Observations** (see also the table shown on the next page) Award 1 mark for two correct points (*) in the table	**5**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>Table of Observations for 3(b)(i)
<table>
<tr><th>test</th><th>observations with FB 8</th><th>observations with FB 9</th></tr>
<tr><td>To a 1 cm depth in a test-tube, add a few drops of acidified potassium manganate(VII)</td><td>yellow / yellow-brown / brown / orange / orange-brown / red-brown coloration (formed) *</td><td>$KMnO_4$ decolorised / purple to colourless *</td></tr>
<tr><td>To a 1 cm depth in a test-tube, add an equal volume of dilute nitric acid, then add a few drops of aqueous barium nitrate, then</td><td>no (visible) reaction / no change / no precipitate / solution remains colourless / goes (pale) yellow *</td><td>no (visible) reaction / no change / no precipitate / solution remains colourless

and</td></tr>
<tr><td>add a few drops of aqueous silver nitrate.</td><td>(pale) yellow precipitate (formed) *</td><td>no (visible) reaction / no change / no precipitate / solution remains colourless *</td></tr>
<tr><td>To a 1 cm depth in a boiling tube, add an equal volume of aqueous sodium hydroxide and warm carefully, then</td><td>no (visible) reaction / no change / no precipitate / solution remains colourless / no gas *</td><td>no (visible) reaction / no change / no precipitate / solution remains colourless / no gas *</td></tr>
<tr><td>add a strip of aluminium foil.</td><td>fizzing / bubbling / effervescence
or
gas / H_2 pops with lighted splint *
litmus turns blue is CON
any other ‘positive’ gas test is CON</td><td>Fizzing / bubbling / effervescence *
<u>gas / NH_3</u> turns litmus blue *</td></tr>
</table></td><td></td></tr>
</table>

Question	Answer	Marks
3(b)(ii)	$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$	**1**
3(b)(iii)	A*l* / aluminium is oxidised (not 'aluminium ions') **and** Nitrite/nitrate ion is reduced / N^{5+} / N^{3+} (not '**FB 9** reduced')	**1**
3(c)(i)	At first: no change / stays colourless / goes yellow / light brown **and** With acid: goes brown / orange-brown / red-brown / yellow-brown / yellow	**1**
3(c)(ii)	I_2 *(formula required)*	**1**
3(c)(iii)	Add starch **and** mixture goes dark blue / blue-black (ignore state) **OR** Add sodium thiosulfate **and** brown colour disappears / brown decolourised / iodine colour fades / solution goes colourless	**1**